

Causal Analysis of California Biologically Impaired Waters

The Salinas River Case Study *17 October 2012*



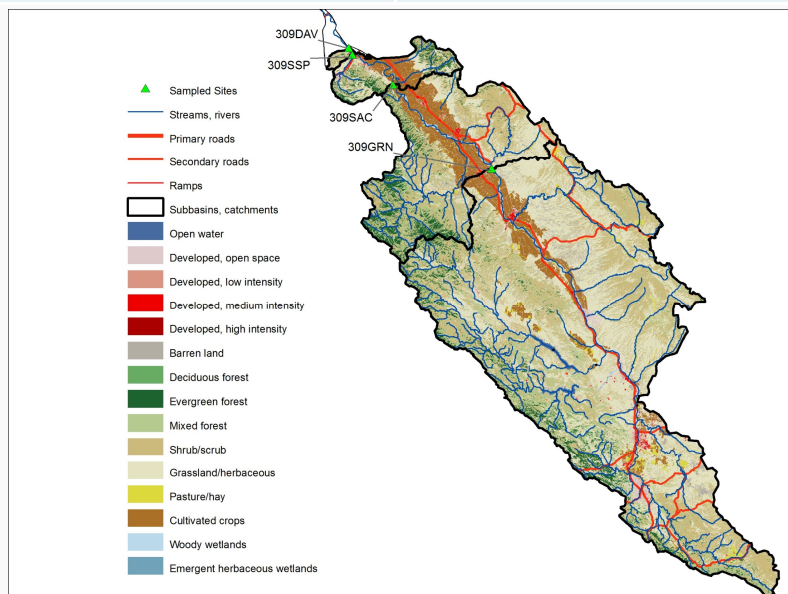
Southern Coastal California Water Resources Project
California Department of Fish and Game
Environmental Protection Agency

The Salinas River- Step 1 Case Definition

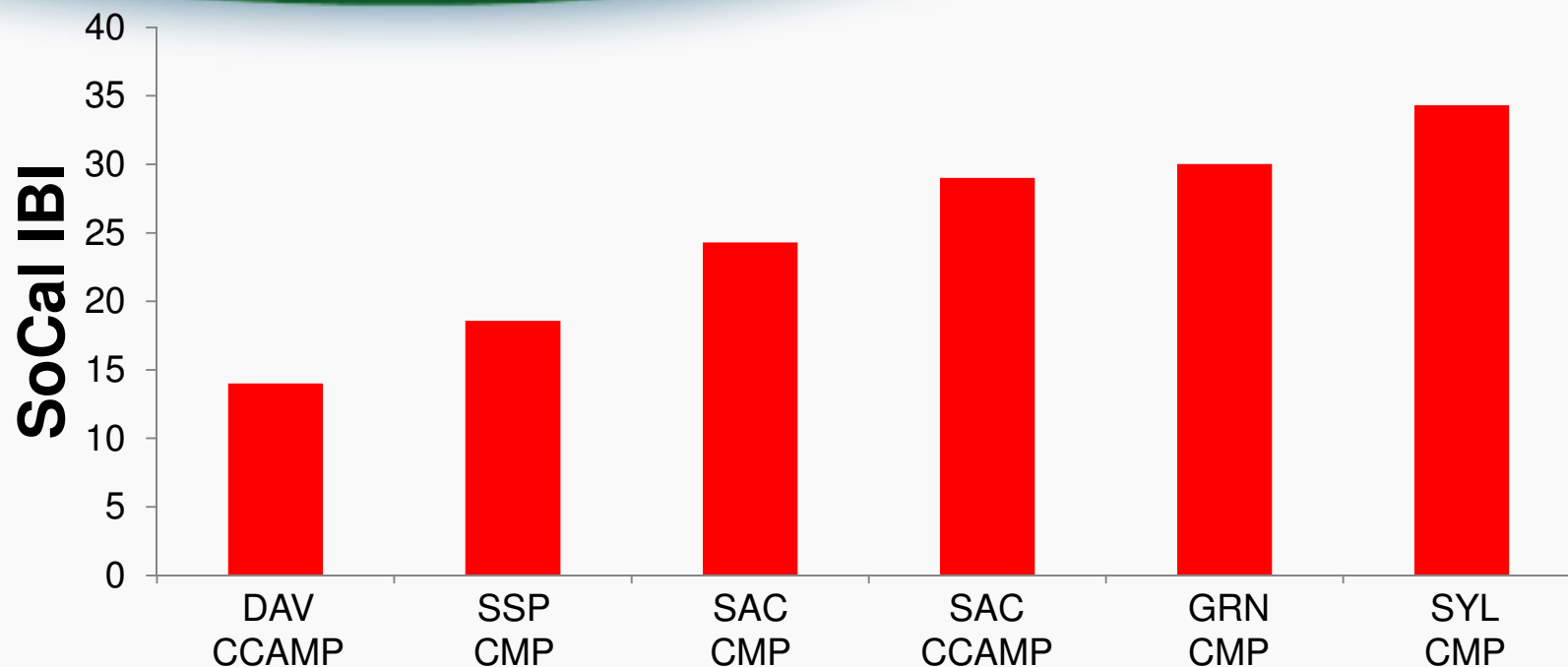


Salinas River	
Length	282 km
Basin	10,774 km ²
Discharge	12 (0-2690) m ³ /sec
Mean Annual Discharge	268,699 acre-feet
Precipitation	28-84 cm/yr

Designated Uses
municipal and domestic water supply
agricultural supply
industrial process supply
industrial process supply
groundwater recharge
water contact recreation
non-contact water recreation
wildlife habitat
cold freshwater habitat
warm freshwater habitat
migration of aquatic organisms
commercial and sport fishing

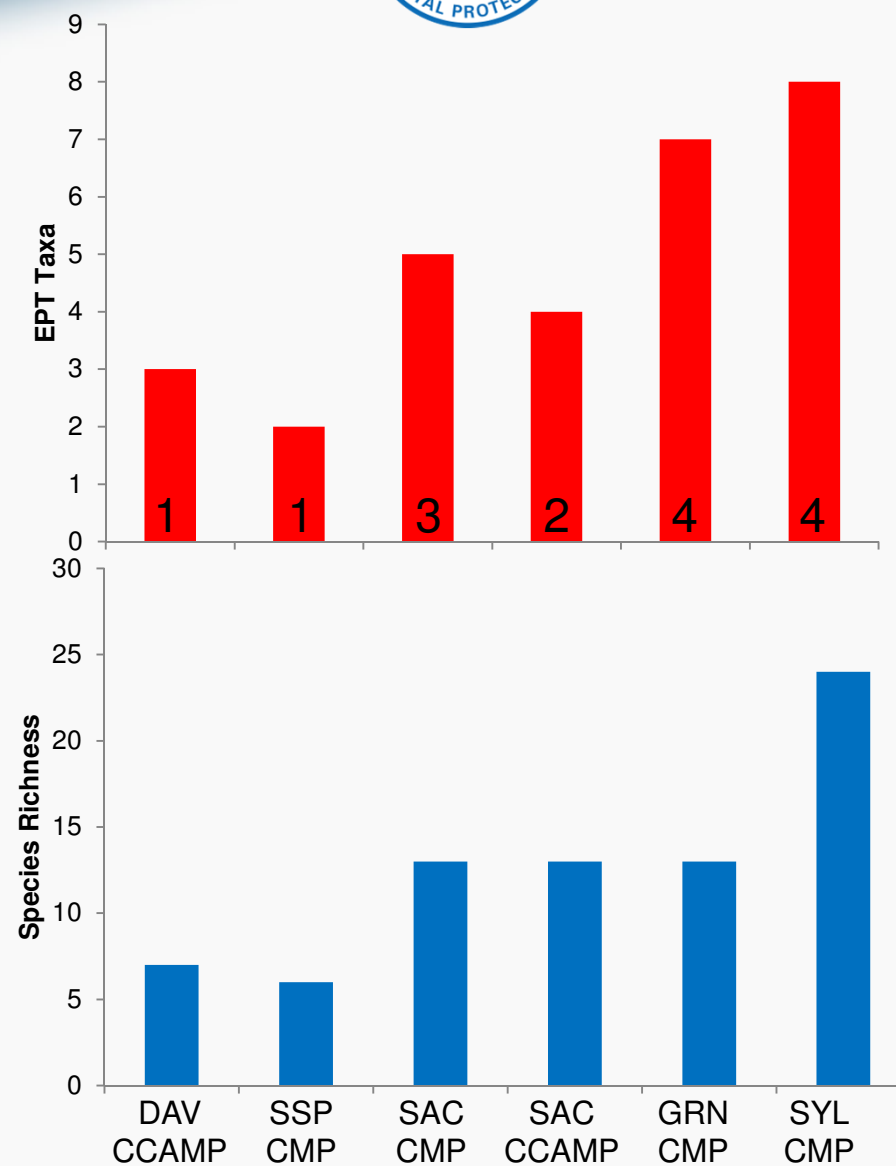
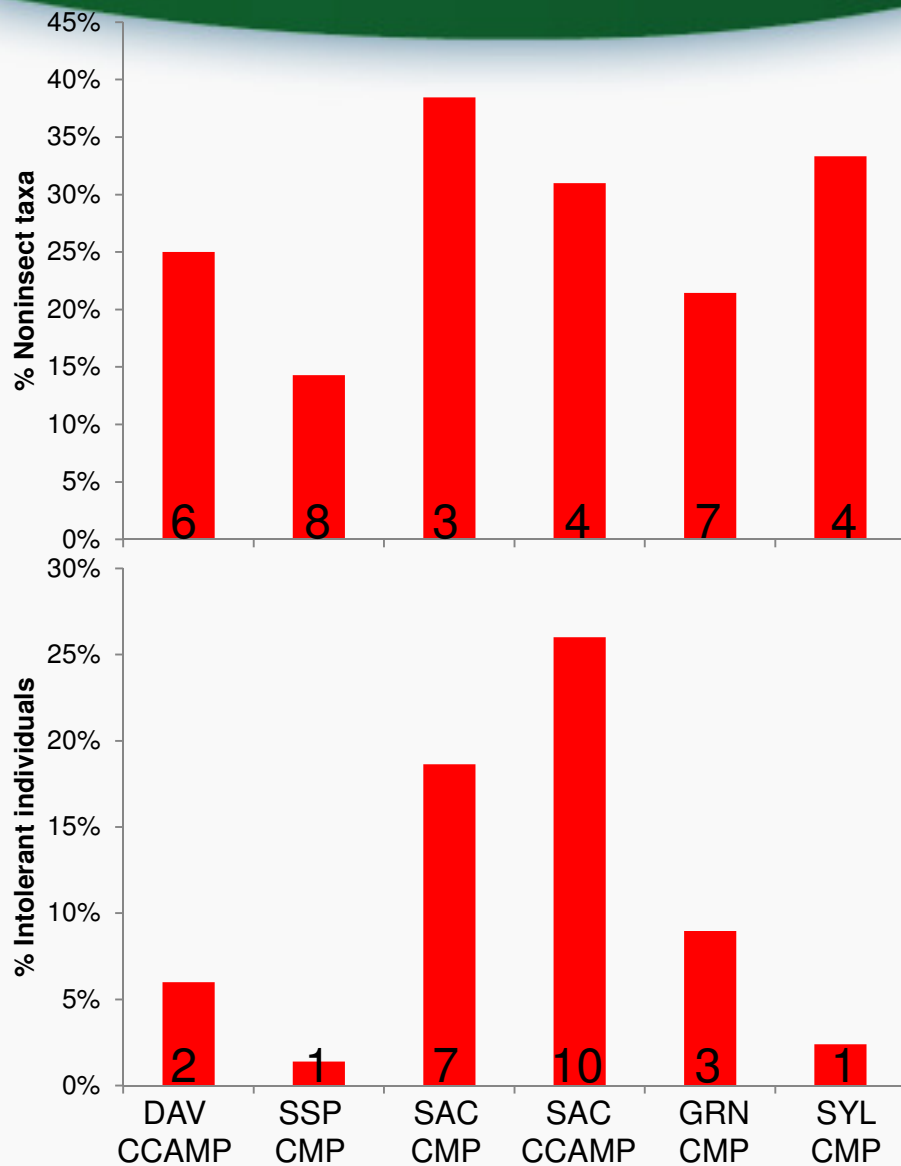


The Salinas River- Step 1 Case Definition



	309DAV	309SSP	309SAC	309SAC	309GRN	309GRN	314SYL
	CCAMP	CMP	CMP	CCAMP	CCAMP	CMP	CMP
SoCal IBI	14	19	24	29		30	34
Sampling Date	6 Jun	26 May	25 May	6 Jun	14 Jun	26 May	14 May

The Salinas River- Step 1 Case Definition



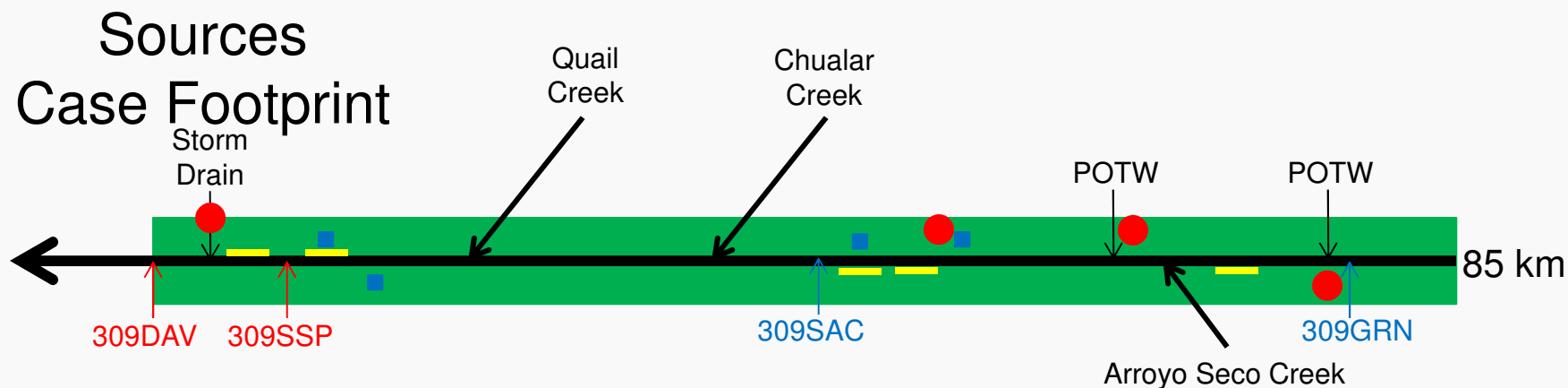
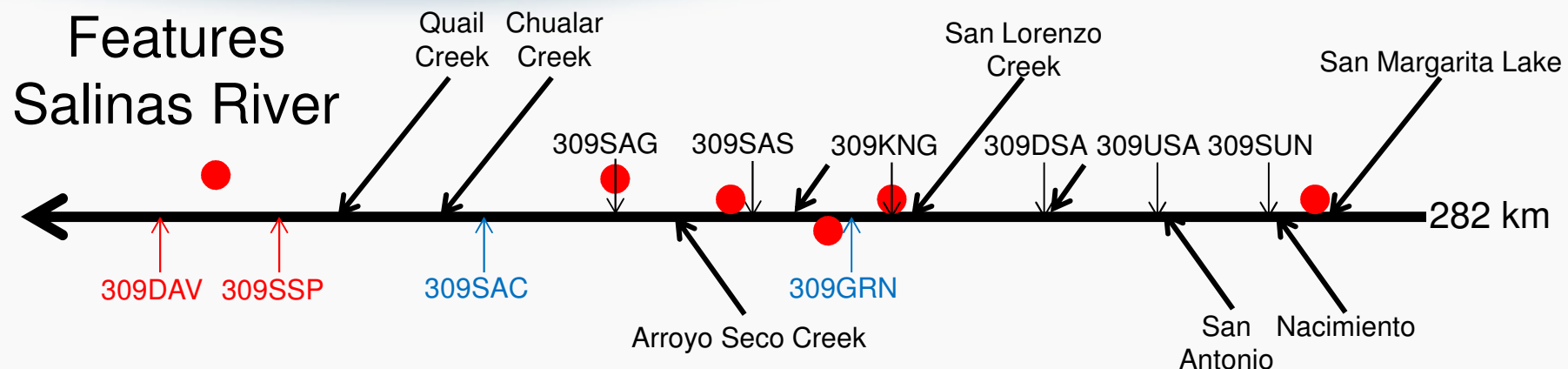
The Salinas River- Step 1 Case Definition



Dominant Taxa 2006

Count (RA%)	309DAV	309SSP	309SAC	309SAC	309GRN	313SYL
	CCAMP	CMP	CCAMP	CMP	CMP	CMP
Chironomidae	178 (36%)	312 (63%)	262 (52%)	22 (37%)	134 (38%)	51 (10%)
Oligochaeta	246 (49%)	168 (34%)	21 (4%)	3 (5%)	12 (3%)	21 (4%)
Tricorythodes	2 (<1%)	3 (1%)	61 (12%)	7 (12%)	68 (19%)	217 (43%)
Centroptilum	29 (6%)	7 (1%)	136 (27%)	11 (19%)	32 (9%)	12 (2%)
Acentrella	0 (0%)	0 (0%)	0 (0%)	1 (2%)	63 (18%)	11 (2%)
Hydropsyche	0 (0%)	0 (0%)	0 (0%)	0 (0%)	2 (1%)	70 (14%)
Total Count	497	498	500	59	356	500

The Salinas River- Step 2 Candidate Causes



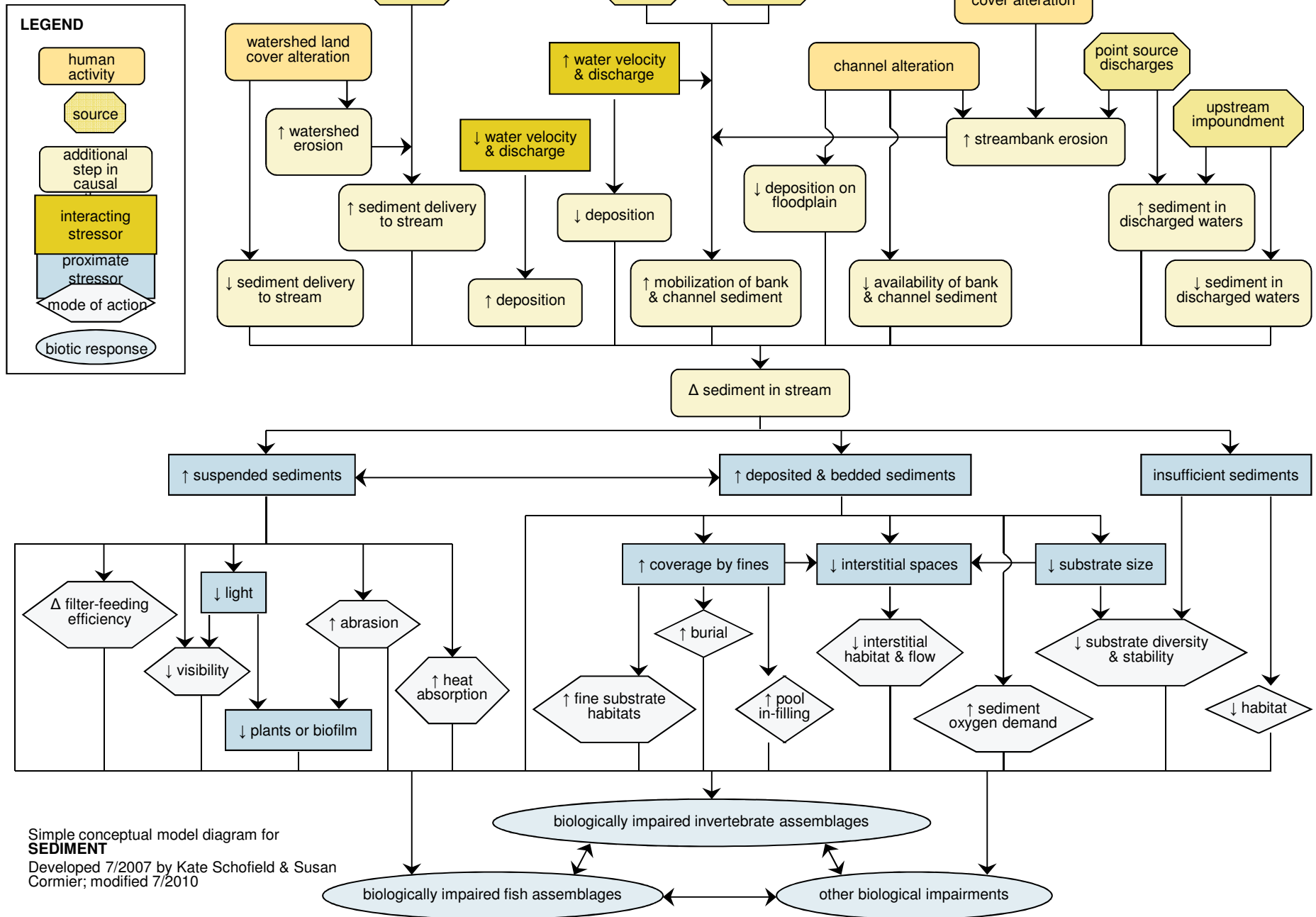
The Salinas River- Step 2

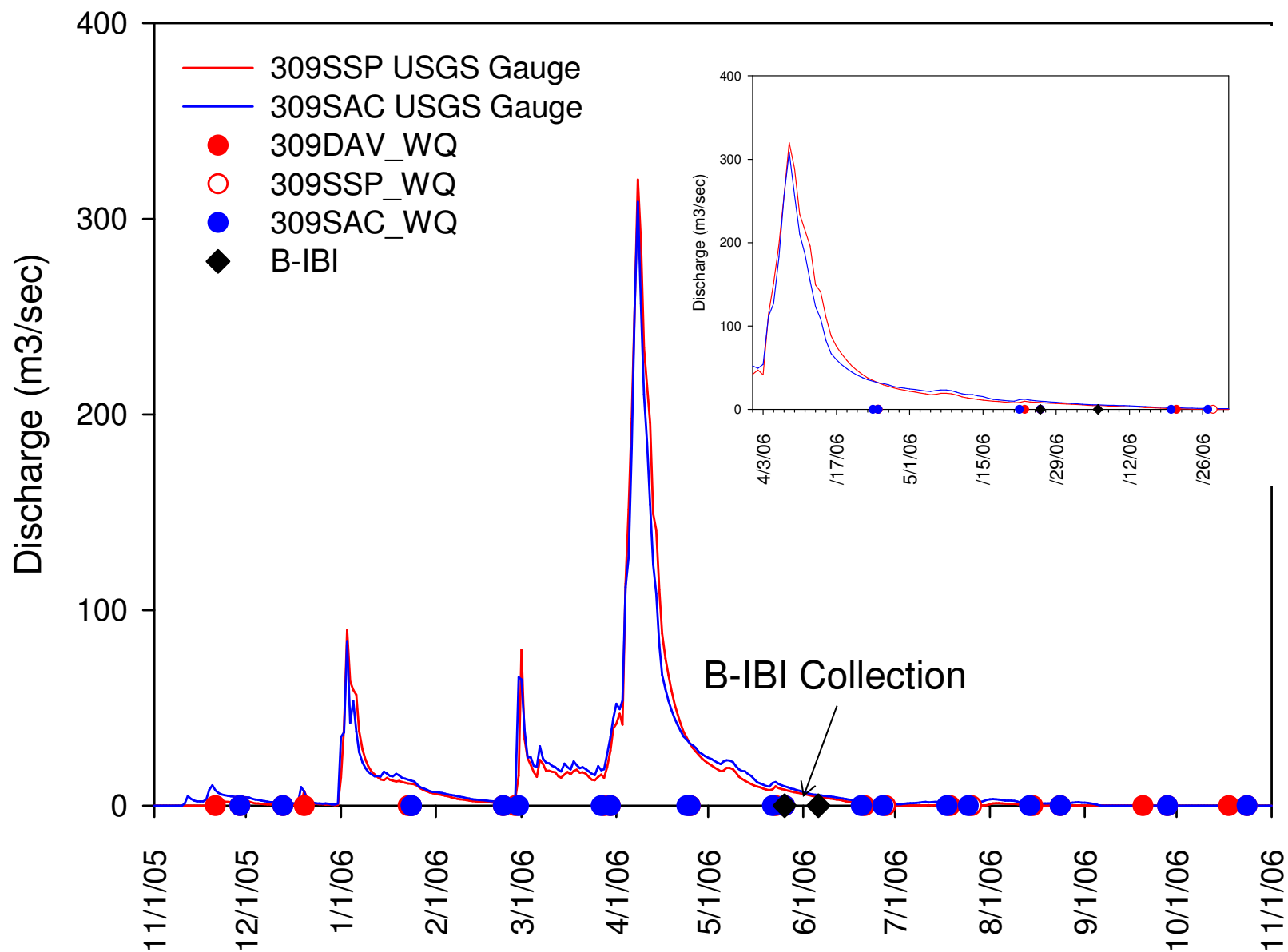
Candidate Causes



- Candidate Causes Narratives and Conceptual Diagrams Developed for
 - Increased Sediments —————→ Identification Example
 - Increased Ionic Strength —————→ Elimination Example
 - Increased Pesticides —————→ Tool Development
 - Decreased Dissolved Oxygen
 - Increased Metals
 - Nutrient enrichment & toxicity
 - Flow Alteration
 - Physical Habitat Alteration

Conceptual Diagram

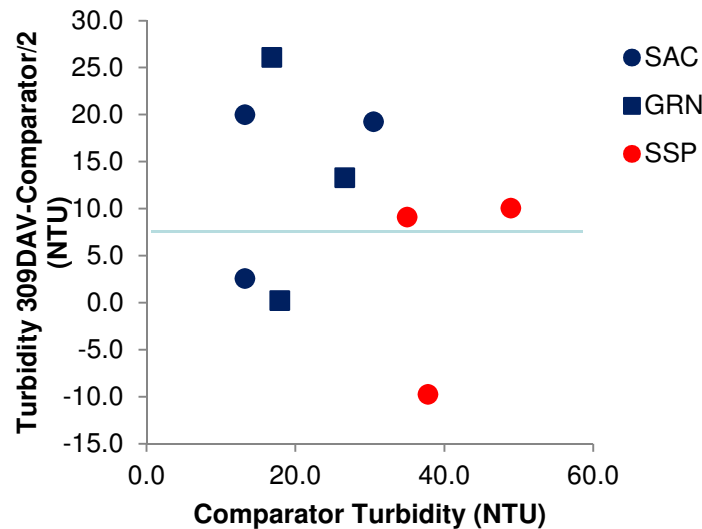
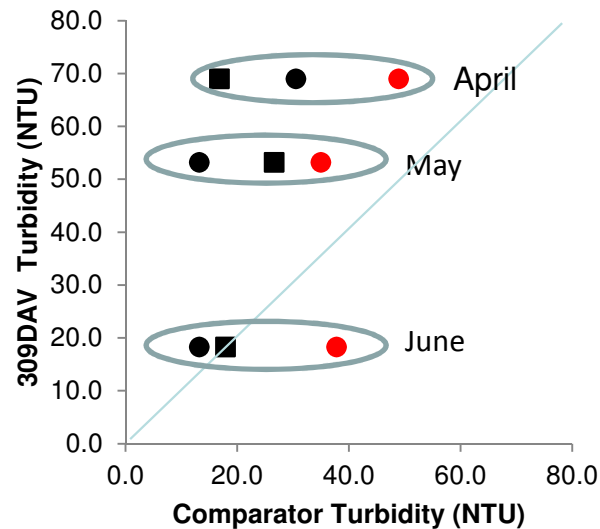




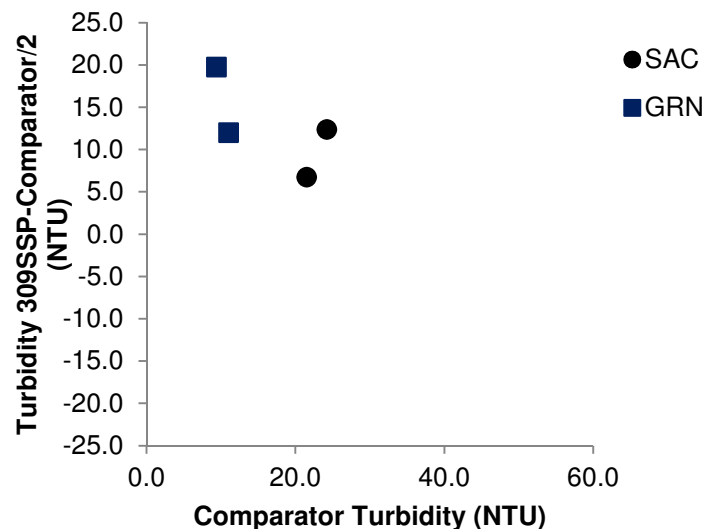
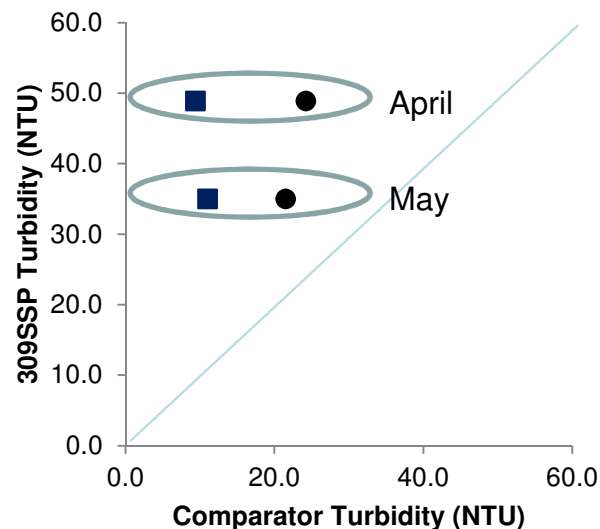
Data Source: USGS Stream Gauges at Spreckels (1152500) and Chualar (1152300).

Data From the Case: Step 3

Spatial/Temporal Co-occurrence: Suspended Sediments

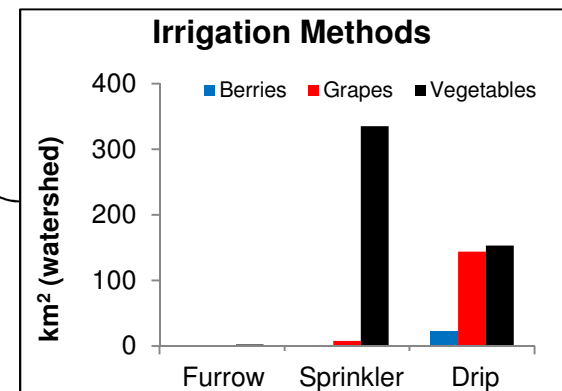
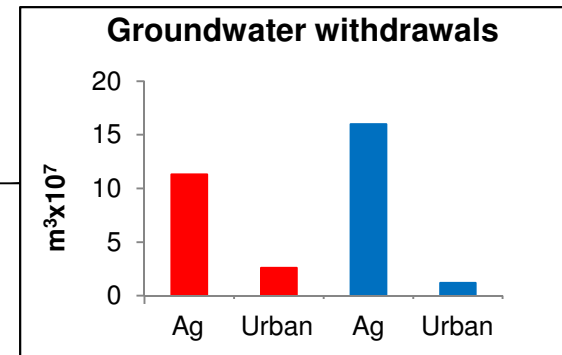
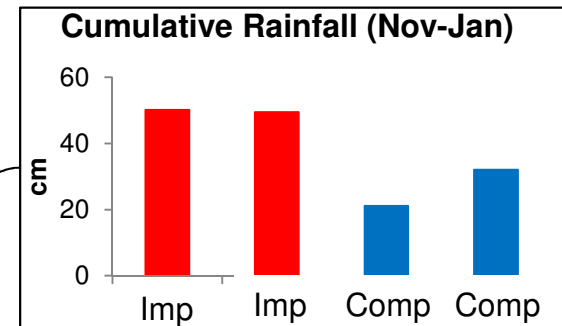
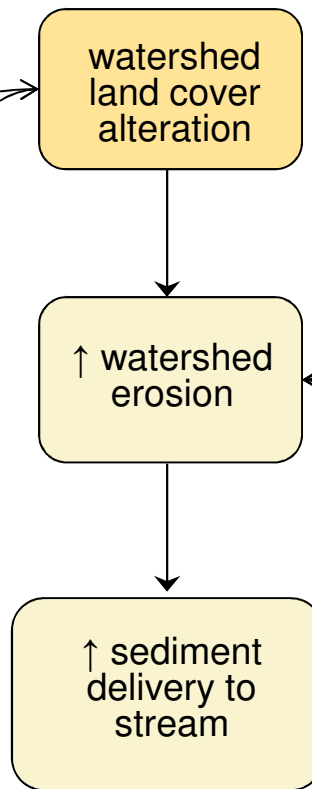
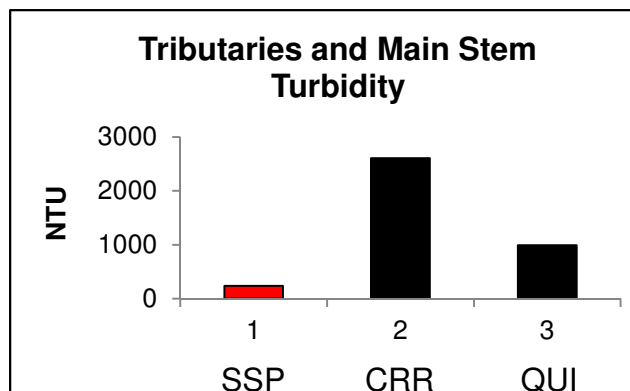
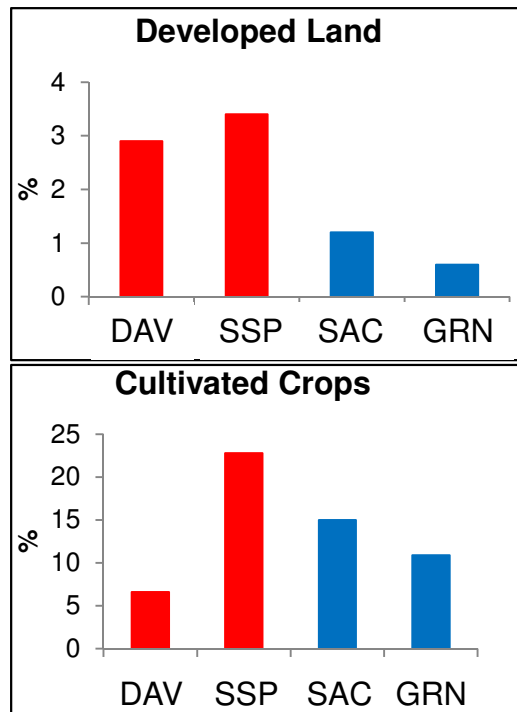


Score: +
Reasoning-
Consistently
greater measures
of suspended
sediments at the
impaired versus
comparator sites



Data From the Case: Step 3

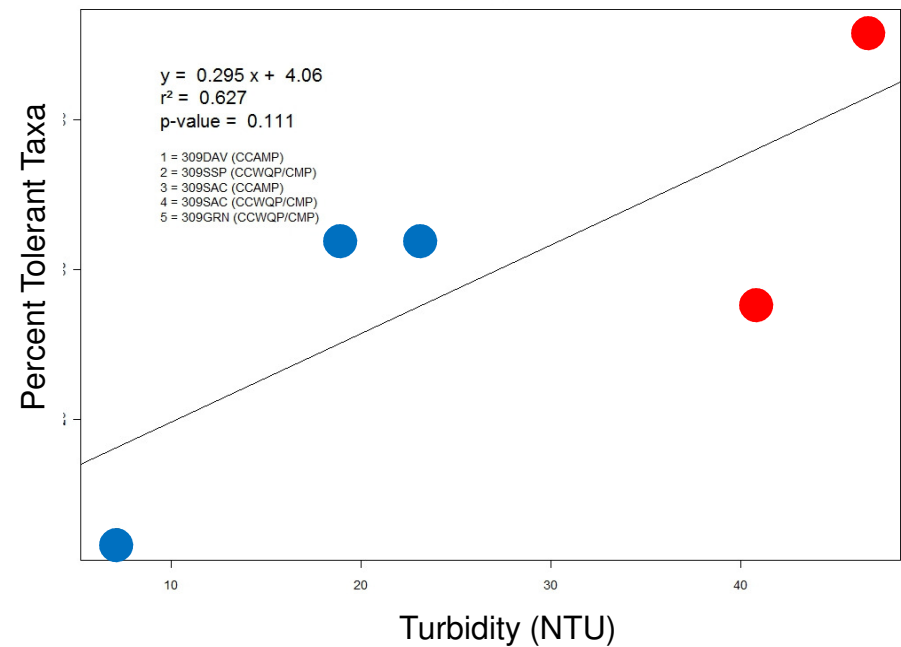
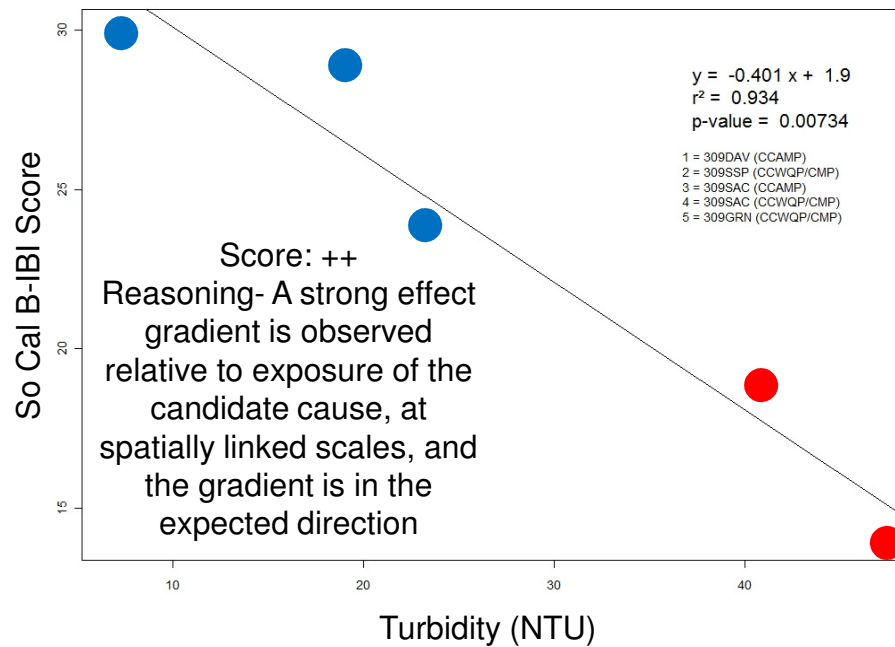
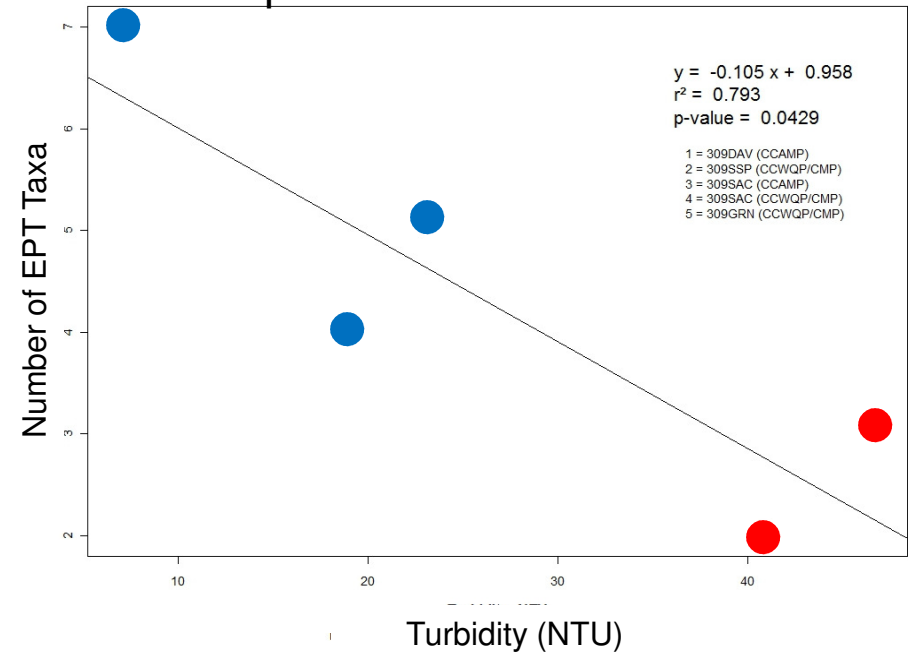
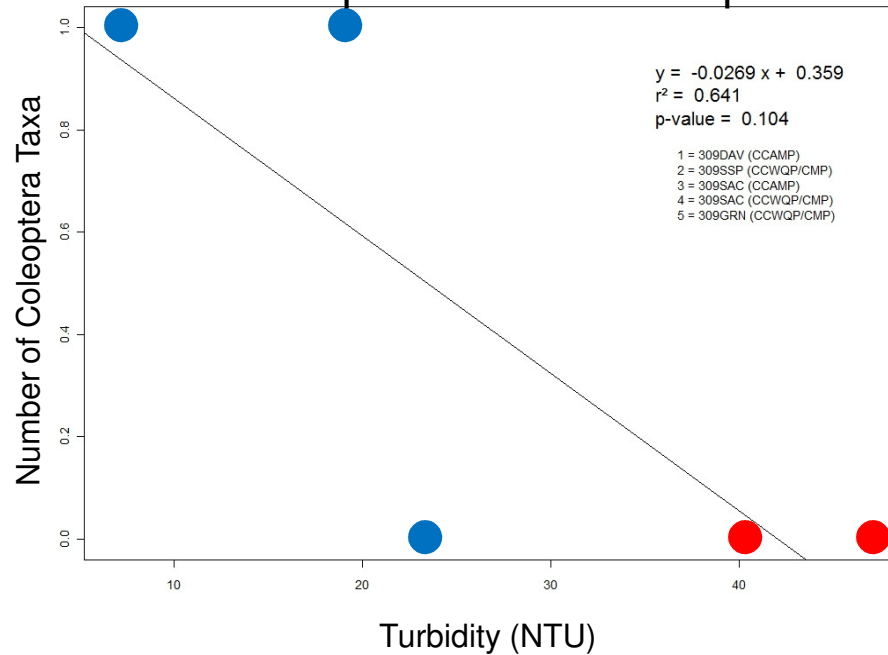
Causal Pathway: Suspended Sediments



Score: +
Reasoning- Some steps in at least one causal pathway are present

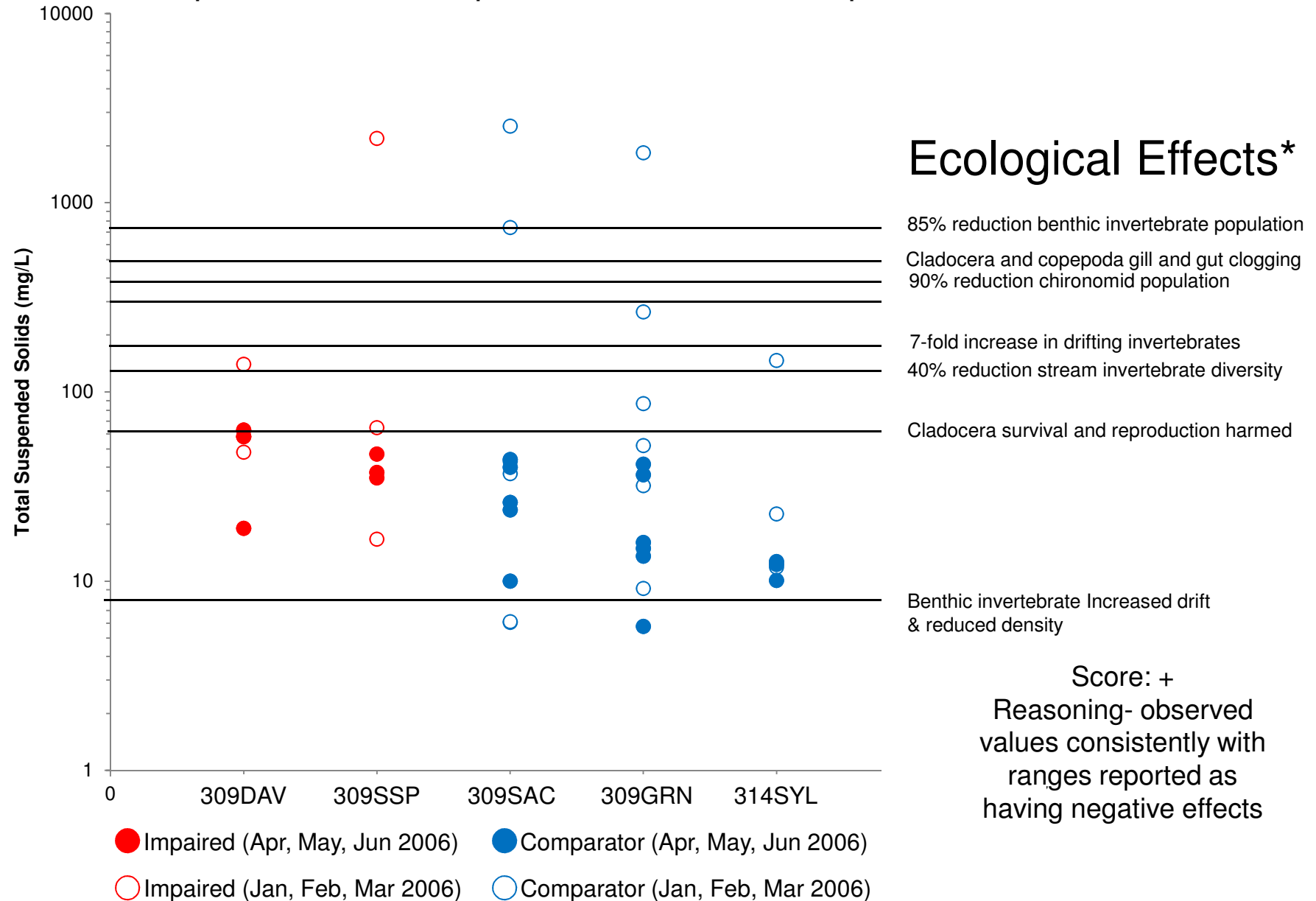
Data From the Case: Step 3

Stressor-Response Relationships from the field: Suspended Sediments



Date from Outside the Case: Step 4

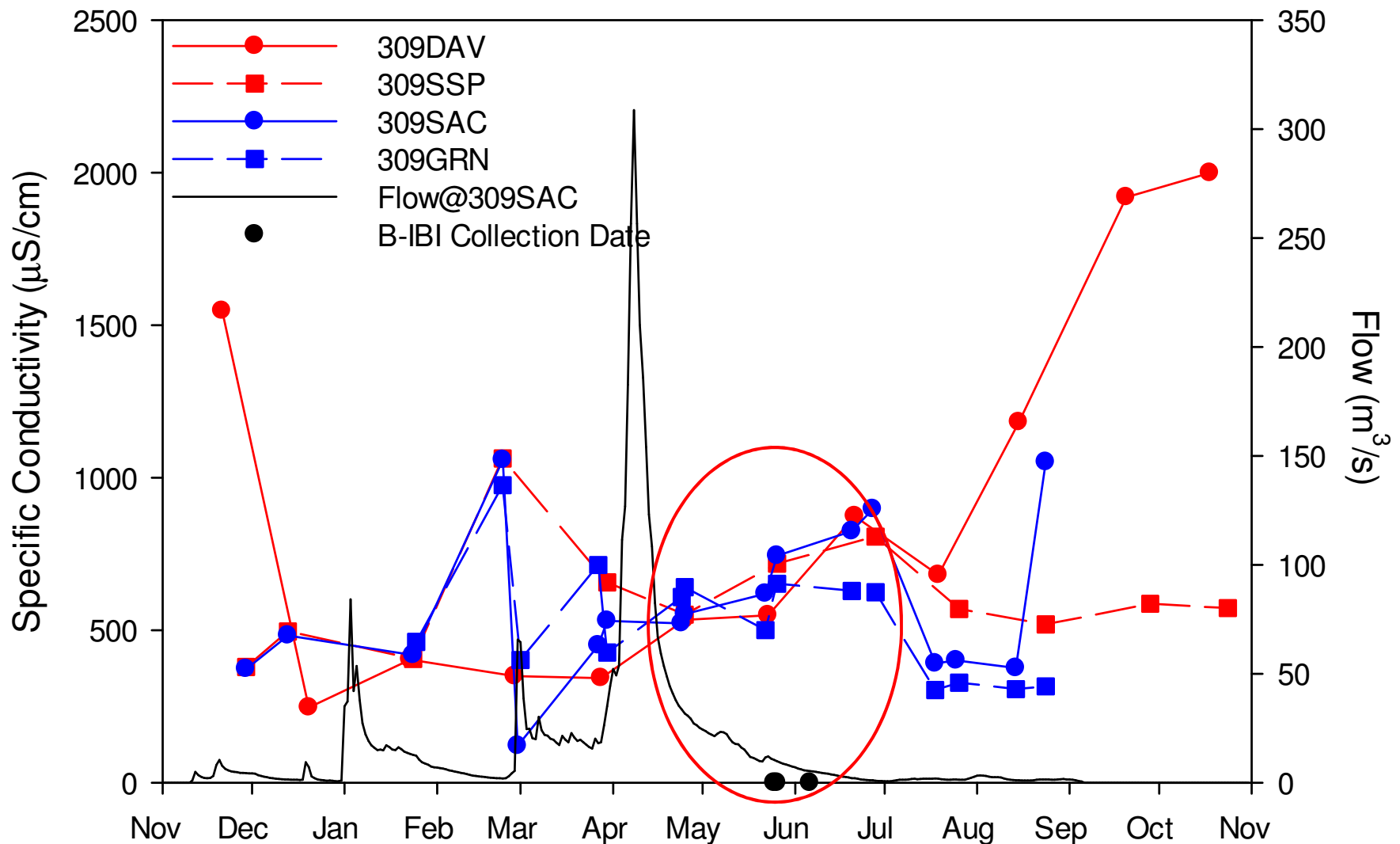
Stressor-Response Relationships from Elsewhere: Suspended Sediment



*From Bilotta and Brazier (2008)

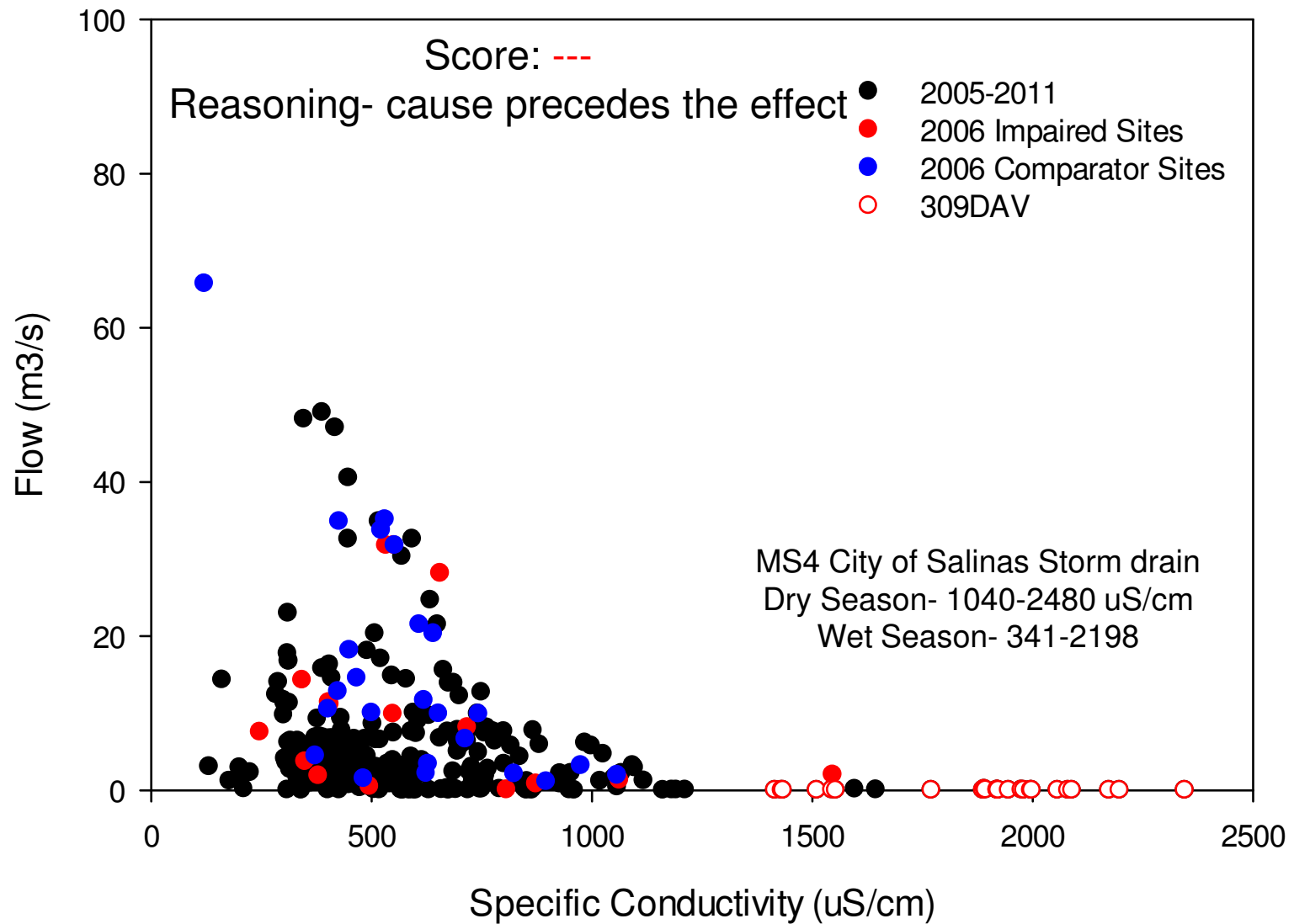
Data From the Case: Step 3

Temporal Sequence: Increased Ions



Data From the Case: Step 3

Temporal Sequence: Increased Ions



Scoring Summary- Step 5



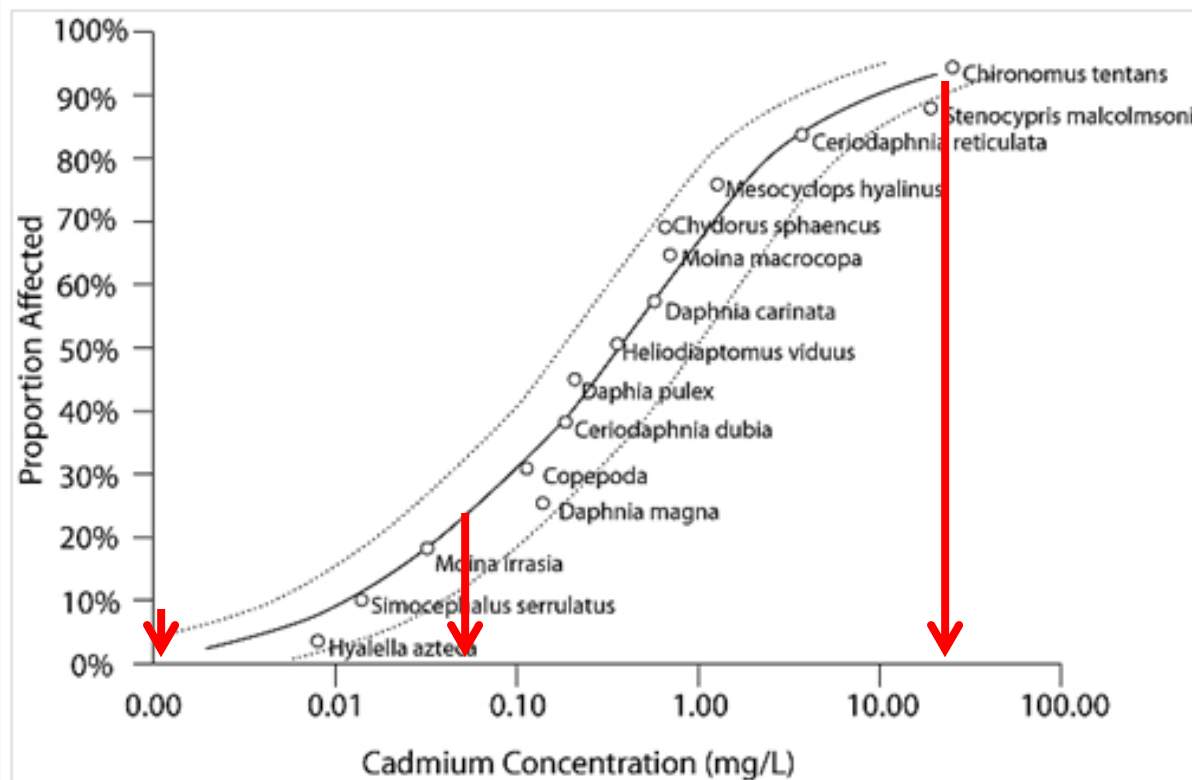
309DAV against 309SAC	Decreased DO	Increased Pesticides	Metals	Increased Nutrients	Increased Ionic Strength	Increased Sediment (Bed)	Increased Sediment (Susp)	Altered Flow Regime	Altered Physical Habitat
Types of Evidence that Use Data from the Case									
Spatial/Temporal Co-Occurrence	-	NE	NE	+	---	---	+	-	-
Causal Pathway	0	+	0	0	0	-	+	0	+
Stressor-Response from the Field	-			-	-	-	++	+	
Laboratory Test of Site Media		-	-						
Temporal Sequence				---	---		+		
Types of Evidence that Use Data from Elsewhere									
Stressor-Response from Other Field Studies							+		
Stressor-Response from Laboratory		+	+						
Evaluating Multiple Types of Evidence									
Consistency of Evidence	-			-	---	-	+	-	-

New Tool Exploration

Species Sensitivity Distributions



- Species Sensitivity Distributions (SSD) are models of the variation in sensitivity of species to a particular stressor
- Constructed using laboratory toxicity data

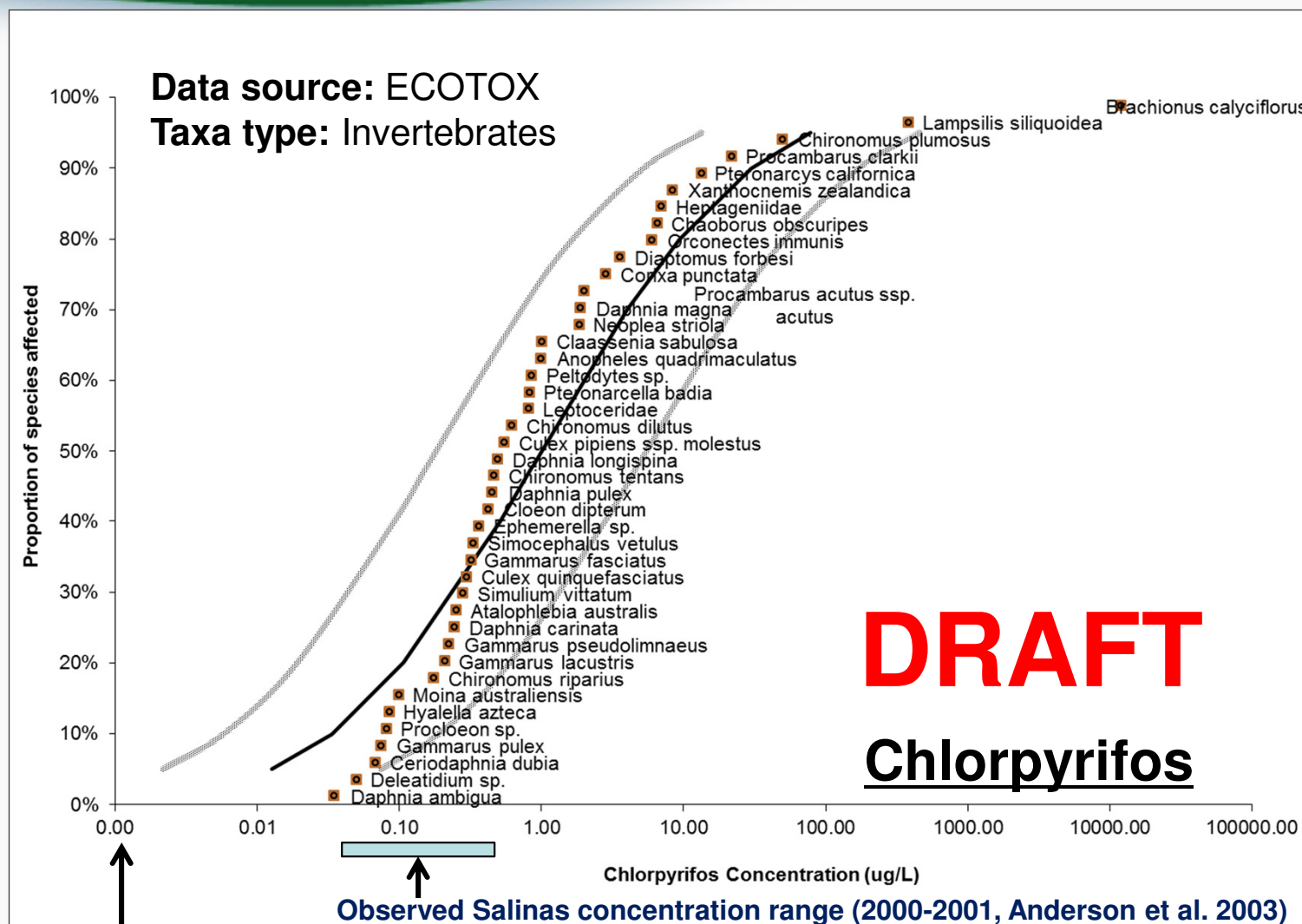




2010 California Pesticide Summary

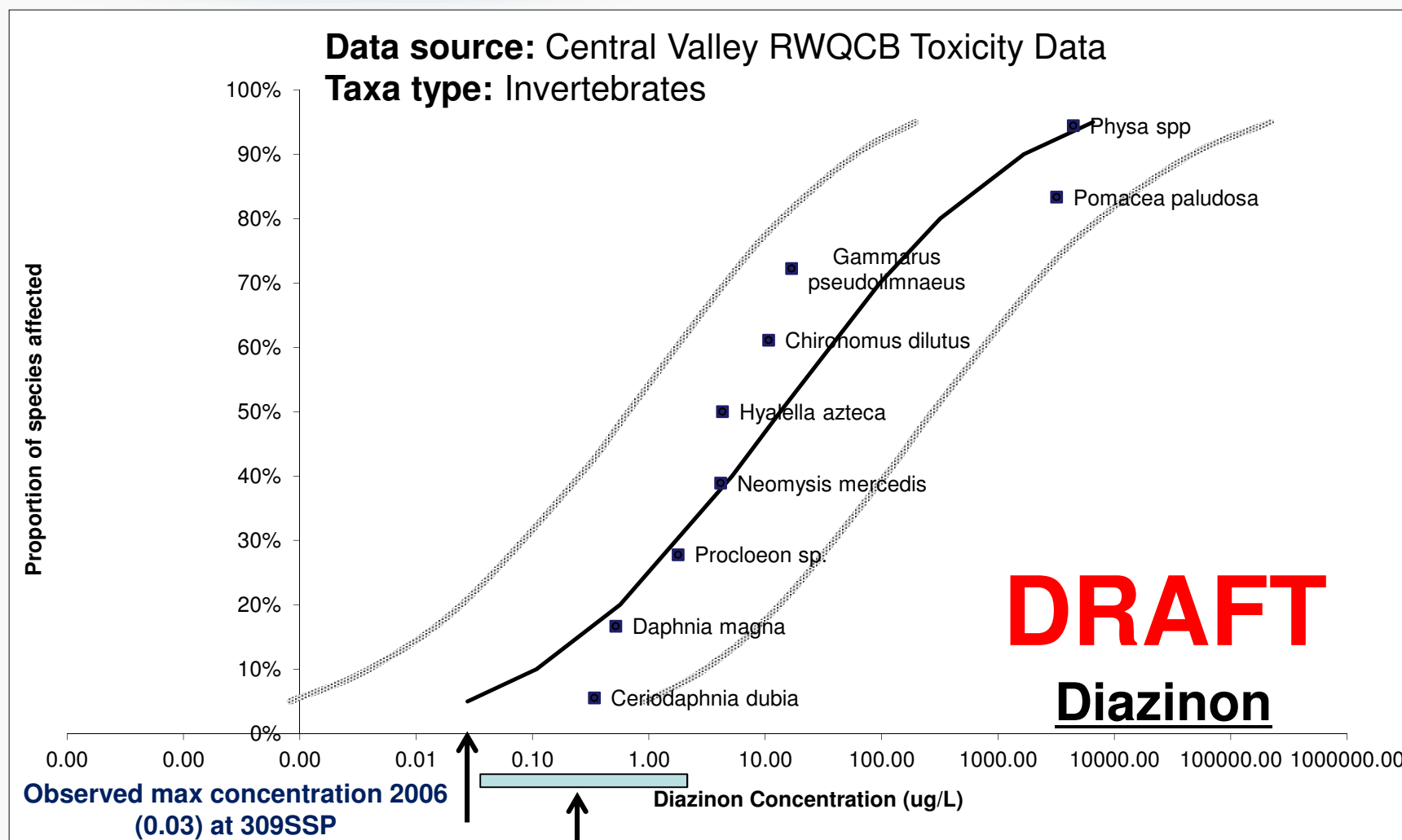
- 173 million pounds of pesticides applied (active ingredient)
- 631 million pounds of pesticide sold (combined active ingredient)
- 896 pesticide products sold
- Few pesticides have water quality standards

New Tool Exploration Species Sensitivity Distributions



Observed max concentration 2006
(0.001) at 309SAC/309SSP

New Tool Exploration Species Sensitivity Distributions



Observed Salinas concentration range (2000-2001, Anderson et al. 2003)

20

New Tool Exploration

Species Sensitivity Distributions



- SSDs have potential for evaluating toxics
- Some issues to consider
 - Data quality used to construct SSDs
 - e.g., known quality/fewer data vs. unknown quality/more data
 - Use of acute vs. chronic endpoints
 - Currently using acute endpoints in SSD tool of CADDIS
 - Chronic endpoints would require more interpretation
 - Miscellaneous technical decisions
 - Studies use pure chemicals vs. product formulations

Final Conclusions: Likely Contributors



Candidate Cause	Evidence and comments
Suspended sediments	Concentrations consistently higher at subject sites relative to comparator; Concentrations at levels associated with effects in other studies
Physical habitat	Especially as influenced by suspended sediments

Final Conclusions: Unlikely Contributors



Candidate Cause	Evidence and Comments
Dissolved oxygen	Concentrations similar between subject and comparator sites; however, data was limited.
Nutrients	Concentrations peak and differences occur well after invertebrate samples are collected.
Ionic Strength	Concentrations peak and differences occur well after invertebrate samples are collected.
Flow Regime	Flow regimes are similar among the subject and comparator sites.

Final Conclusions: Significant Questions Remain



Candidate Cause	Evidence and Comments
Pesticides	Very limited data available for assessment.
Metals	Very limited data available for assessment.

Lessons Learned For Causal Assessment in California



- Targeted Biological Objectives Monitoring Plan
 - Maximize efforts to collect possible stressor parameters in the months preceding B-IBI.
 - Sediment and water column pesticides, metals, & PAHs
 - Tradeoffs
 - more parameters fewer data points
 - more data points fewer parameters
 - High frequency measures of DO
- Not all Biological Objectives (organisms) are created equal
 - Organisms differ in sensitivity to proximate stressors
 - Benthic Invertebrates
 - Algae
 - Fish

Acknowledgements



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- The views expressed in this presentation are those of the authors and do not necessarily reflect the views or policies of the U.S. Environmental Protection Agency.